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"Pass the Peas
like we use to
say it!"



Genetics:

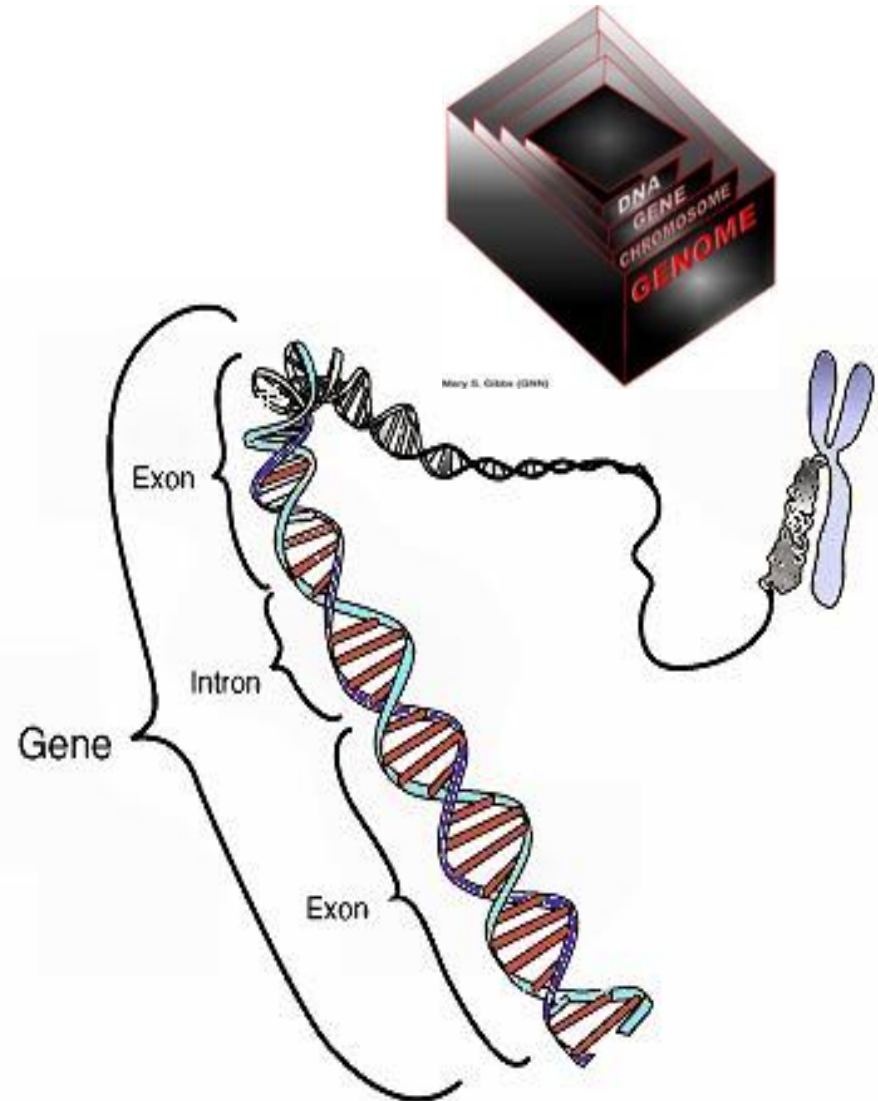
Mendelian Inheritance & Heredity



Google logo honoring Gregor Mendel, 20 July 2011

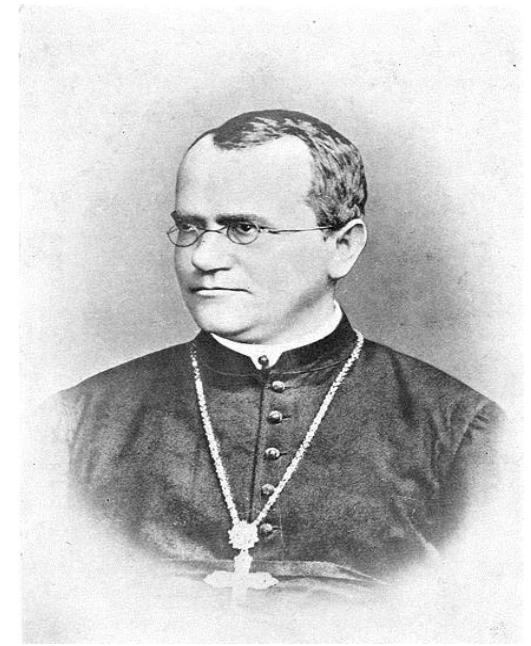
Genetics Terminology: Chromosomes & Genes

- - Complete complement of an organism's DNA.
- Cellular DNA is organized in .
- have specific places on chromosomes.



So who was Mendel?

- Once upon a time (1860's), in an Austrian monastery, there lived a monk named Gregor Mendel.
- Mendel spent his spare time breeding pea plants.
- He did this over & over & over again, and noticed patterns to the inheritance of traits, from one set of pea plants to the next.
- By carefully analyzing his pea plant numbers, he discovered three laws of inheritance.
- Mendel's Laws are as follows:
 1. Law of Dominance
 2. Law of Segregation
 3. Law of Independent Assortment
- *In his work, the words "[chromosomes](#)" or "genes" are nowhere to be found. The role of these things in relation to inheritance & heredity had not been discovered yet.*
- *What makes Mendel's contributions so impressive is that he described the basic patterns of inheritance before the mechanism for inheritance (namely genes) was even discovered!*



The dude
was a
total
GENIUS!

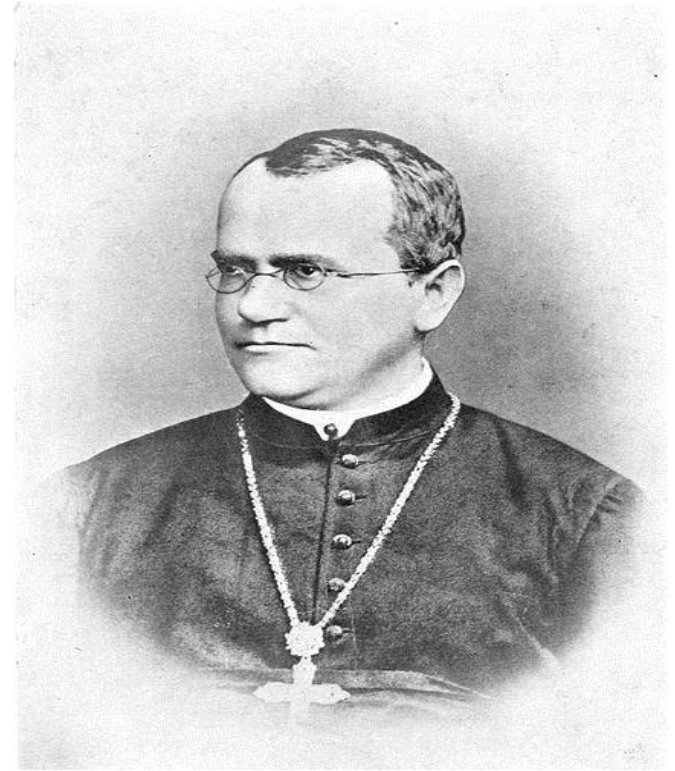


First, a little more genetics terminology.

Then...

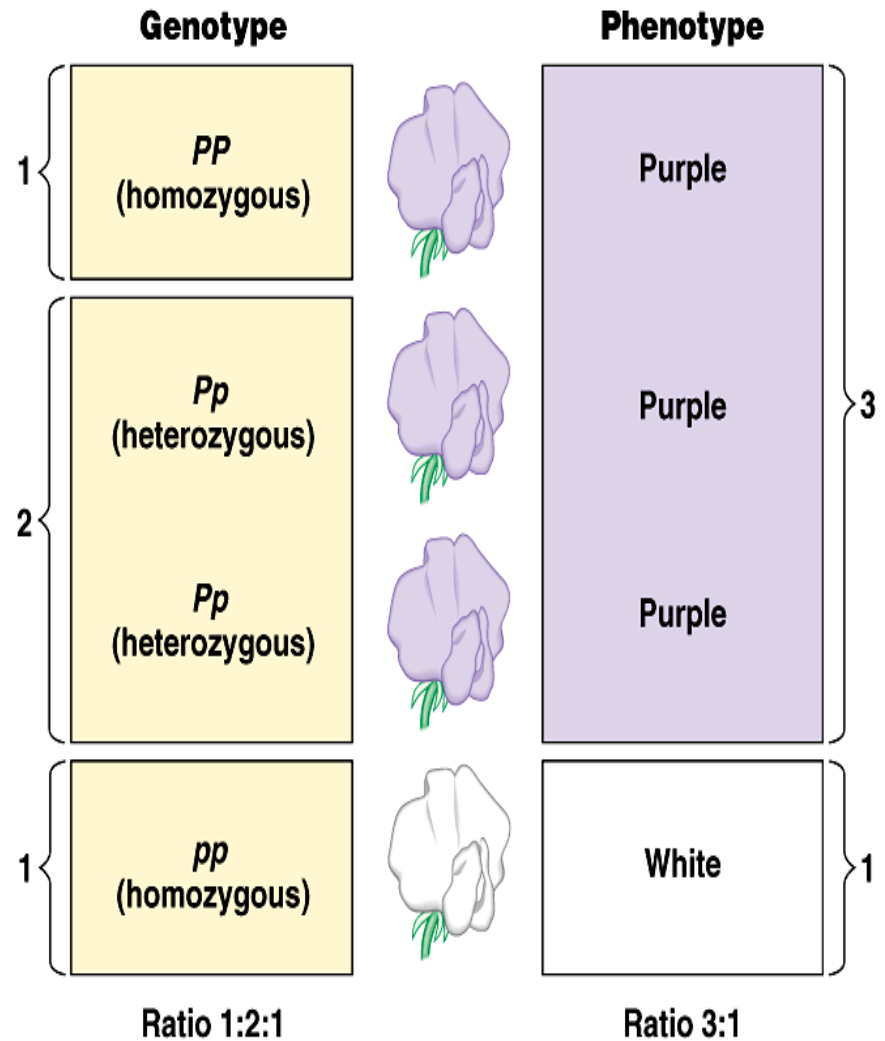
Mendel's Laws

1. Law of Dominance
2. Law of Segregation
3. Law of Independent Assortment



Genetics Terminology

- : the genes of an organism (*all your genes*)
- : an organism's traits (*expression of your genes*)
- : variations of a gene
- Represented with letters for the different types of **alleles** (PP, Pp, pp)
- : pair of identical alleles for a character (PP, pp)
- : two different alleles for a gene (Pp)



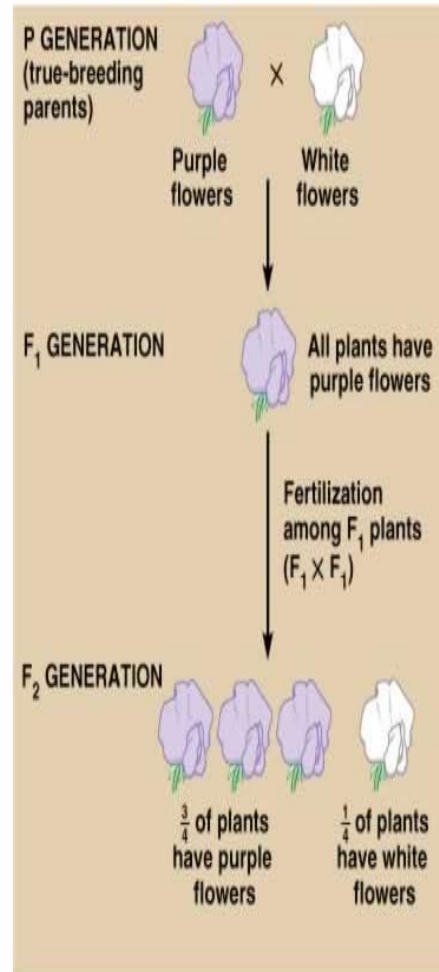
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Genetics Terminology

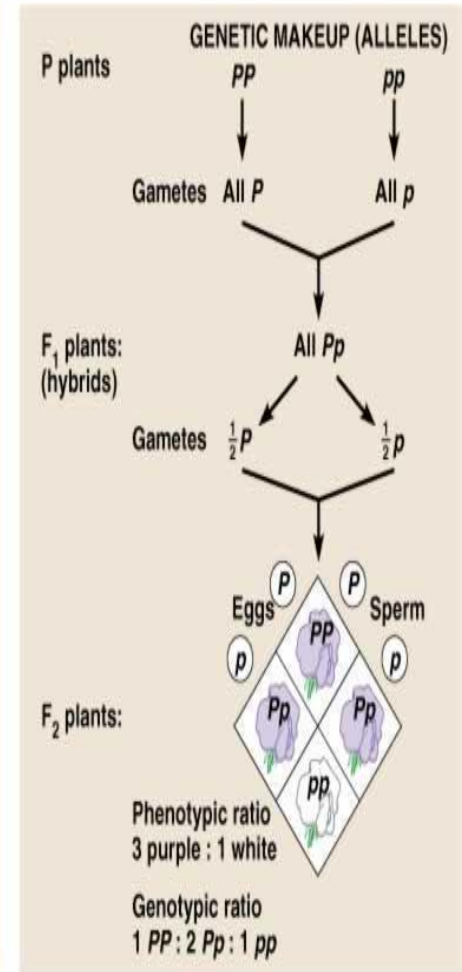
- **Character:** heritable feature (i.e., fur color)
- **Trait:** variant for a character (i.e. brown)
- **True-bred:** all offspring of same variety
- **Hybridization:** crossing of 2 different true-breds

We label the different generations of a cross as:

- **P generation** (parents)
- **F₁ generation** (1st filial generation)
- **F₂ generation** (2nd filial generation)



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Genetics Terminology

Dominant & Recessive

Genotypes & Phenotypes

_____ genotype:

Both recessive alleles must be present (rr).

_____ genotype:

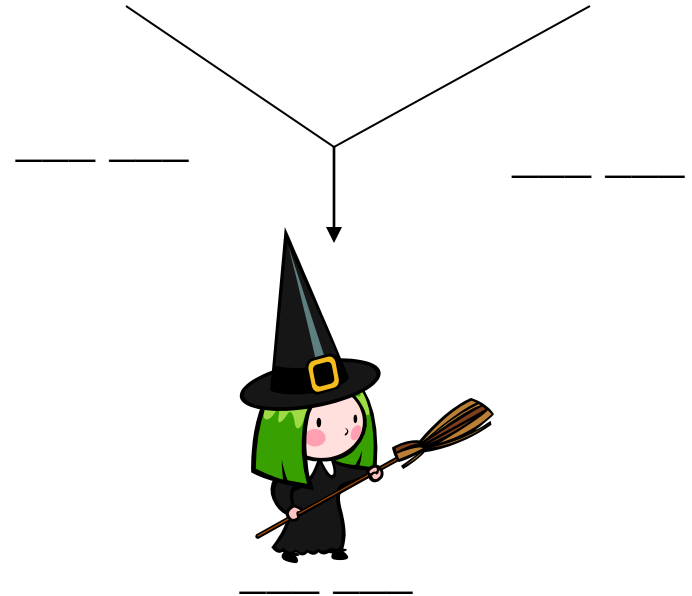
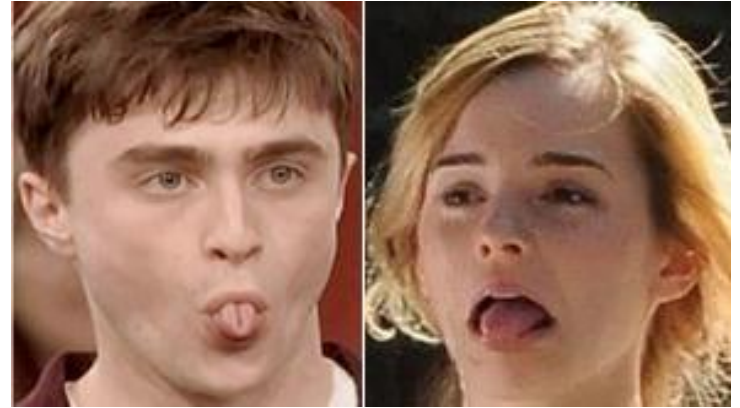
At least one dominant allele is present (R-).

Character: Tongue Rolling

Being able to **roll your tongue** is a dominant phenotype.

Harry: Being able to roll your tongue is the dominant trait (phenotype). *Q:* How would we represent the **genotype** of he was **homozygous dominant**?

Hermione: Not being able to roll your tongue is the recessive (phenotype). *Q:* What would be the recessive **genotype**?



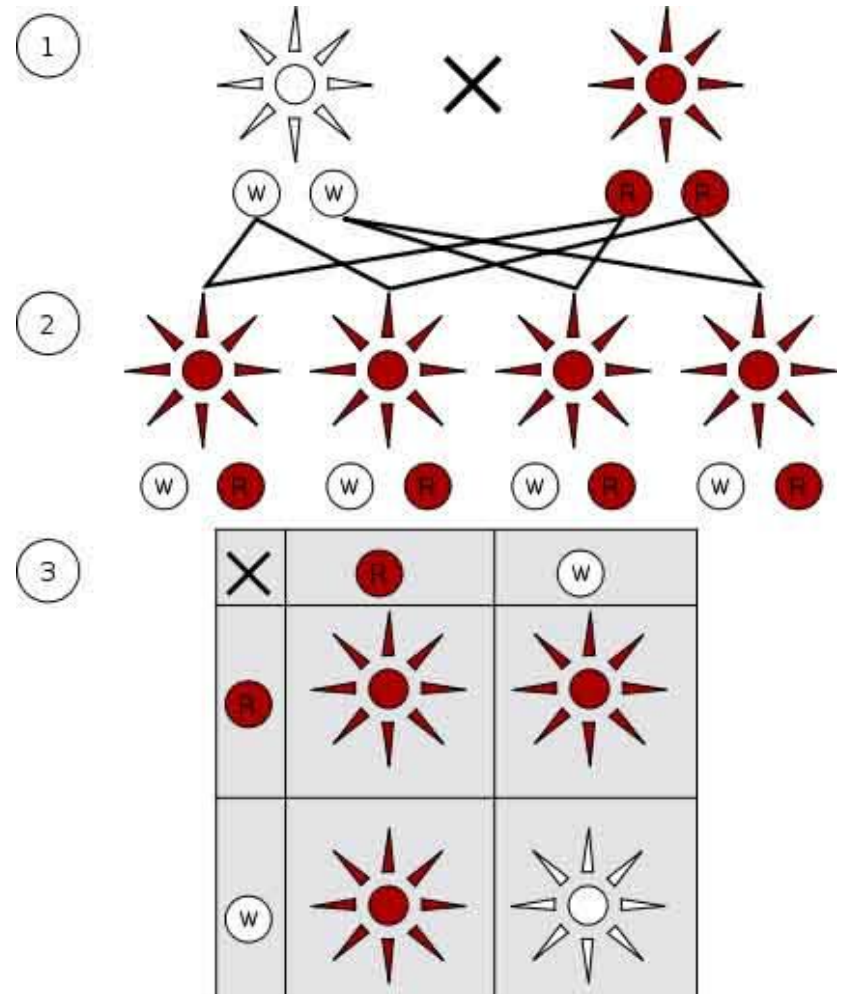
Q: Would "Harriet" be able to roll her tongue?

1. Mendel's Law of _____

- In a cross of parents that are pure for contrasting traits, only one form of the trait will appear in the next generation.

- Offspring that are hybrid for a trait will have only the dominant trait in the phenotype.

Q: On last slide: If Harry's was heterozygous, what are the possible genotypes for Harriet?



2. Mendel's Law of

- Alternative versions of genes (**alleles**) result in variations in inherited characteristics.
- For each character, an organism inherits 2 alleles (one from each parent).
- The alleles for each character segregate (**separate**) during gamete production (_____).
- Alleles for a trait are recombined at fertilization, becoming genotype for the traits of the offspring.

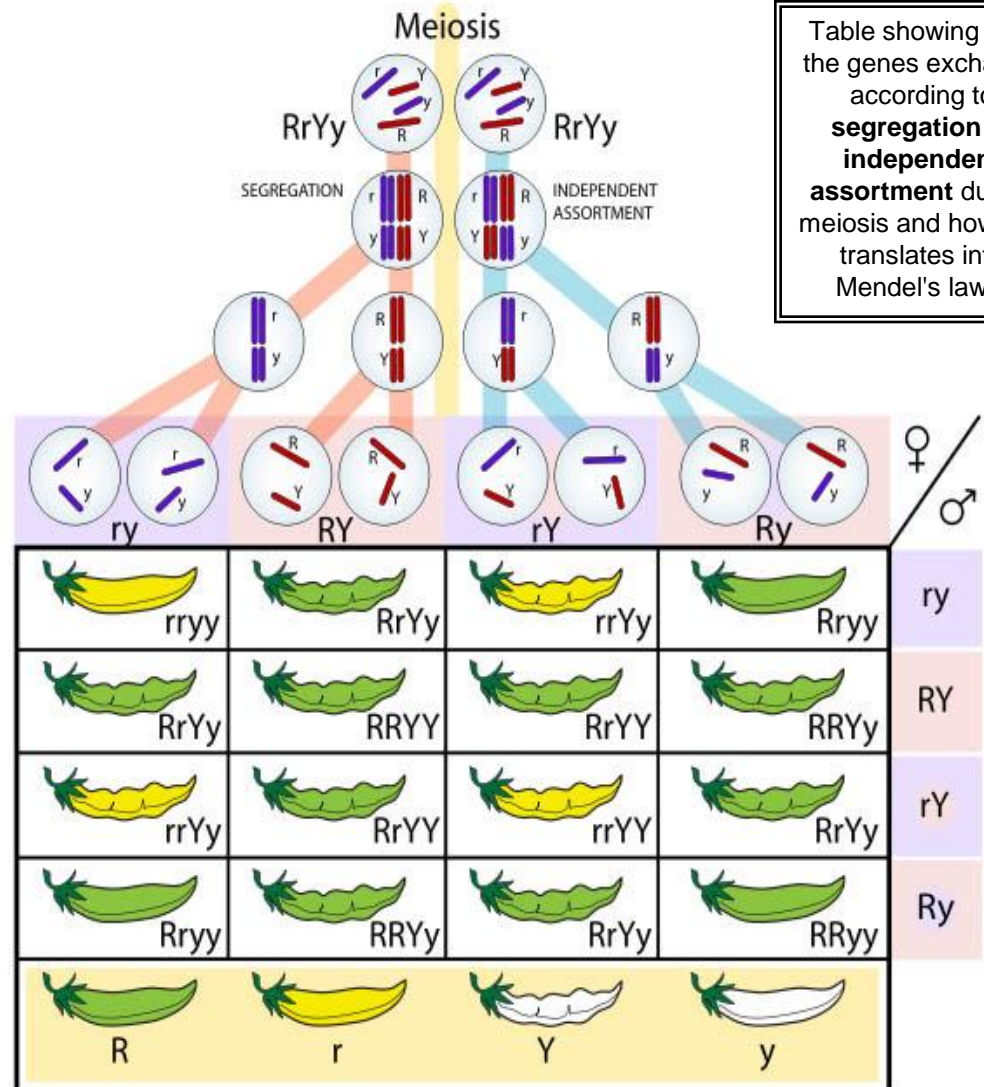


Table showing how the genes exchange according to **segregation** or **independent assortment** during meiosis and how this translates into Mendel's laws.

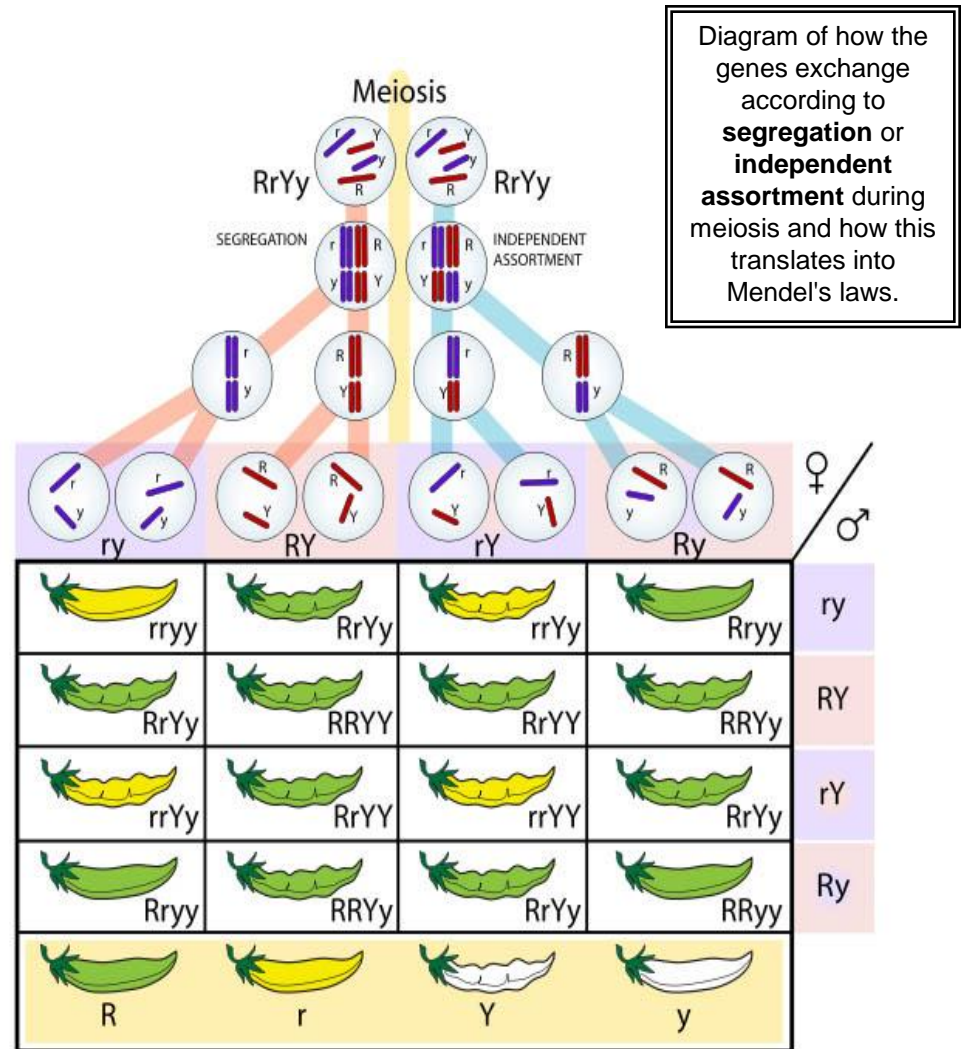
3. Mendel's Law of

Alleles for *different* traits are distributed to sex cells (& offspring) independently of one another.

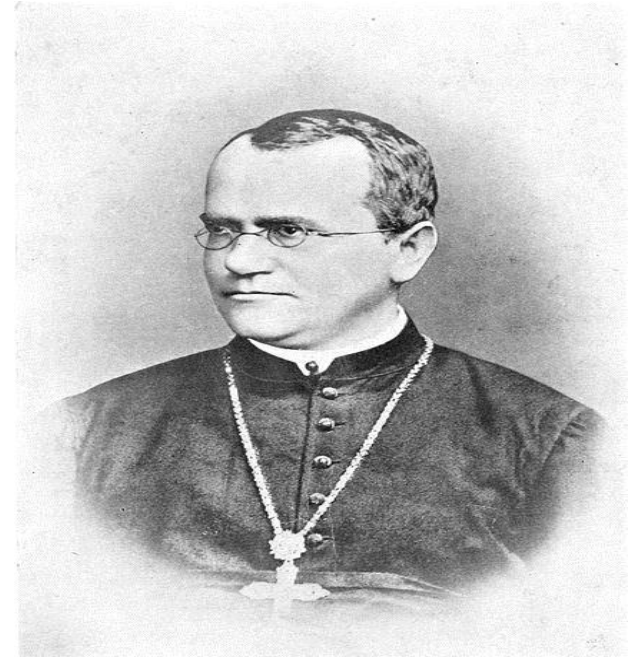


HELP! Show me a video!

*Remember...Mendel came up with this stuff BEFORE we know about the existence of DNA, genes, chromosomes.
WOW!*



Mendel's Laws:



1. Law of Dominance:

- In a cross of parents that are pure for contrasting traits, only one form of the trait will appear in the next generation.
- Offspring that are hybrid for a trait will have only the dominant trait in the phenotype.

2. Law of Segregations:

- During the formation of gametes (eggs or sperm), the two alleles (hereditary units) responsible for a trait separate from each other.
- Alleles for a trait are then "recombined" at fertilization, producing the genotype for the traits of the offspring.

3. Law of Independent Assortment:

- Alleles for *different* traits are distributed to sex cells (& offspring) independently of one another.

Figuring Out Patterns of Inheritance

A **Punnett square** is a tool for diagramming the possible genotypes of offspring.

Let do a Punnett square for the trait of bent little finger (dominant genotype), using letter "B" to represent alleles:

- **DAVID** (the BabyDaddy):
 - dominant phenotype [bent finger]
 - *Q: What is David's genotype?*
- **ME** (the BabyMama):
 - Recessive phenotype [straight finger]
 - *Q: What is my genotype?*

LEO (the BabyBaby):


- Dominant phenotype [bent finger]
- *Q: What is Leo's genotype?*

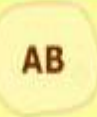


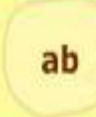























David's Genotype: _____

Tami's
Genotype: _____

_____	_____

Mother

AaBb

	 AB	 Ab	 aB	 ab
 AB	 AABB	 AABb	 AaBB	 AaBb
 Ab	 AABb	 AAbb	 AaBb	 Aabb
 aB	 AaBB	 AaBb	 aaBB	 aaBb
 ab	 AaBb	 Aabb	 aaBb	 aabb

Father

AaBb

So far, we've discussed **Simple Inheritance & Punnett Squares...**

But, of course, genetic is much more complicated than that.

Let's explore:

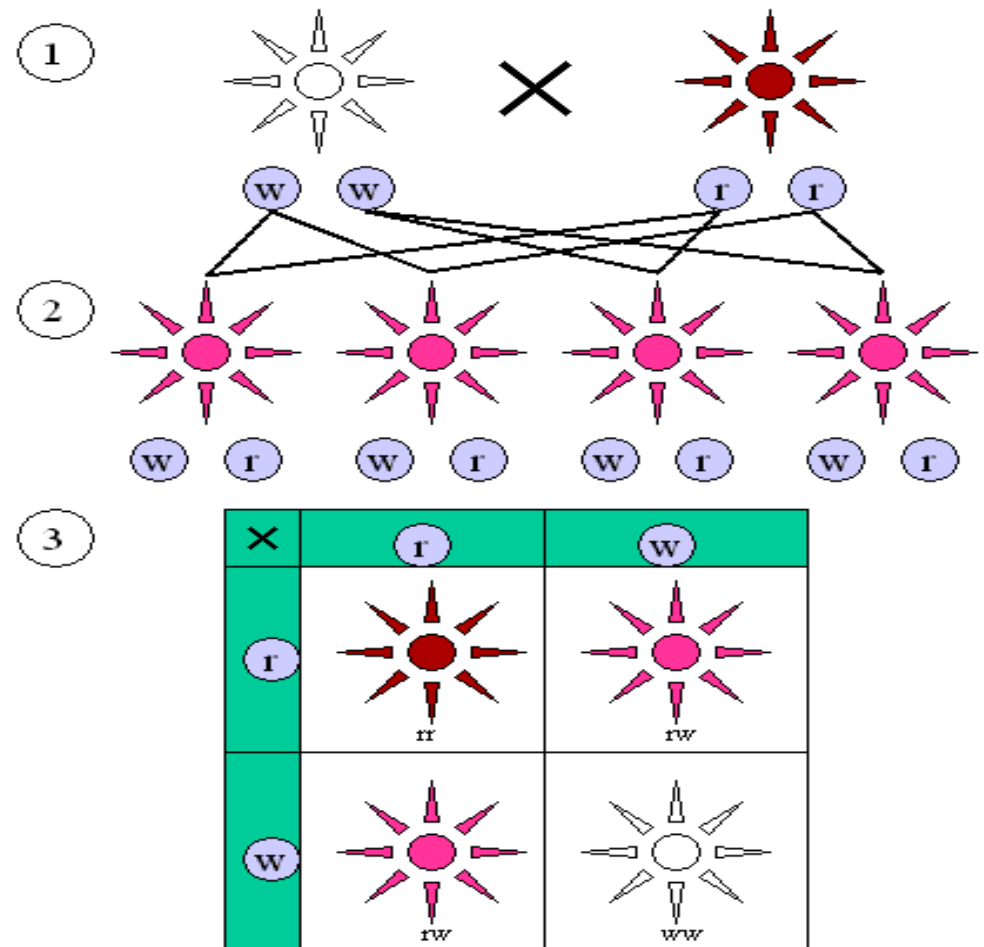
- Incomplete dominance
- Multiple alleles
- Co-dominance

Beyond Simple Inheritance: _____

- Patterns of dominance often go beyond simple dominant or recessive traits.
- Incomplete dominance has "degrees". It is not complete.

F1 generation's appearance between the phenotypes of the 2 parents.


Ex: snapdragons




















The color alleles of *Mirabilis jalapa* are not dominant or recessive.

(1) Parental generation. (2) F1 generation. (3) F2 generation. The "red" and "white" allele together make a "pink" phenotype, resulting in a 1:2:1 ratio of red:pink:white in the F2 generation.

Beyond Simple Inheritance: _____

Mother

AaBb

	AB	Ab	aB	ab
Father  AaBb	 AABB	 AABb	 AaBB	 AaBb
	 AABb	 AAbb	 AaBb	 Aabb
	 AaBB	 AaBb	 aaBB	 aaBb
	 AaBb	 Aabb	 aaBb	 aabb

When there are more than two possible alleles for a gene.

Examples:

- eye color
- human blood types (ABO)

Beyond Simple Inheritance: _____

Two alleles affect the phenotype in separate, distinguishable ways.

Example: AB Blood Type

- has three alleles: A, B & O
- AB co-dominant, O recessive
- genotype represented using I^A , I^B & i

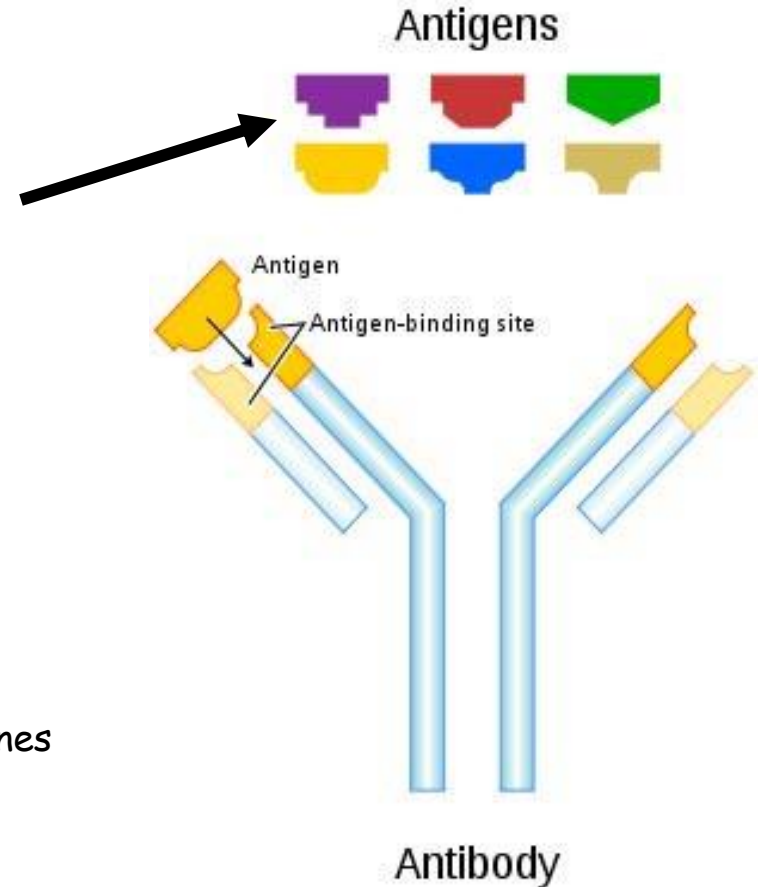


Phenotype	Genotype
Type A	$I^A I^A$ or $I^A i$
Type B	$I^B I^B$ or $I^B i$
Type AB	$I^A I^B$
Type O	ii

A little bit of immunology to help you understand blood types.

Immunology Terms

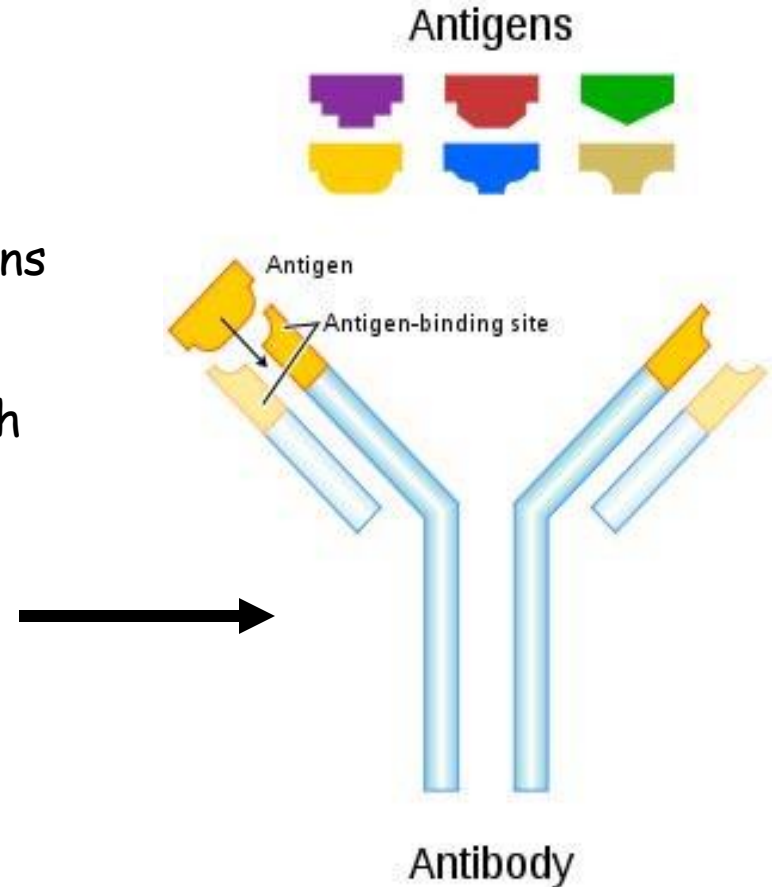
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- Molecules that trigger a specific immune response.
 - Include components of bacterial cell walls, plus proteins of viruses, fungi, protozoa.
 - Food, pollen, and dust can also contain antigenic particles
 - Enter the body by various methods
 - Through breaks in the skin and mucous membranes
 - Direct injection, as with a bite or needle
 - Through organ transplants and skin grafts



A little bit of immunology to help you understand blood types.

Immunology Terms

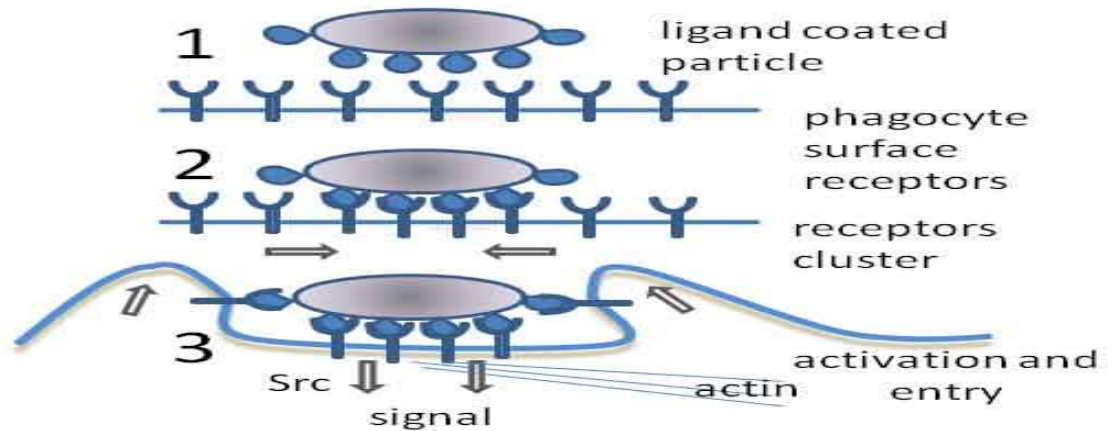
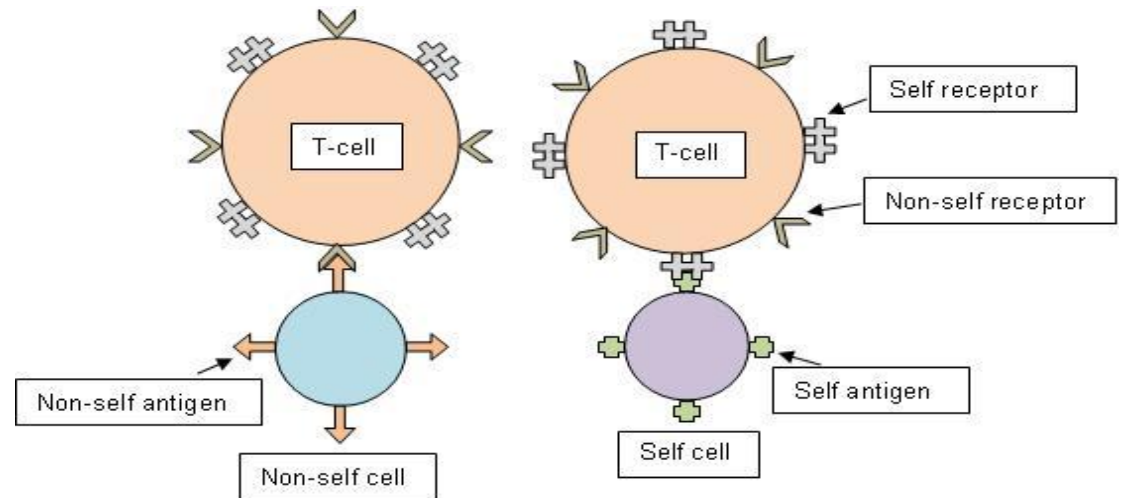
-
- Also called immunoglobulins (Ig)
 - Proteinaceous molecules that bind antigens
 - Considered part of the humoral immune response since bodily fluids such as lymph and blood were once called humors
 - Can act as **labels** to identify antigens for elimination from body.
 - Other antibodies ...
 - work as antitoxins
 - attach to bacterial flagella
 - cause agglutination (clumping together)



A little bit of immunology to help you understand blood types.

Immunology Terms

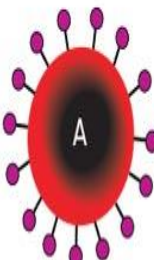
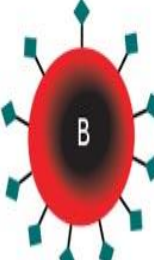
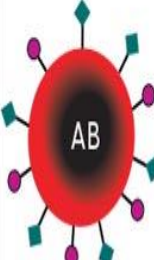
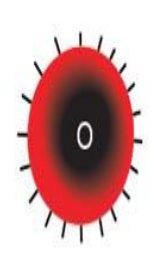


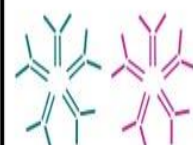



The interaction of antibodies and antigens is how your body tells the difference between **self** and **non-self**.



Co-dominance : _____

- Has three alleles: A, B & O
- AB co-dominant, O recessive
- Genotype represented using I^A , I^B & i

Phenotype	Genotype
Type A	$I^A I^A$ or $I^A i$
Type B	$I^B I^B$ or $I^B i$
Type AB	$I^A I^B$
Type O	ii

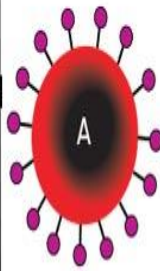
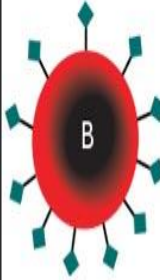
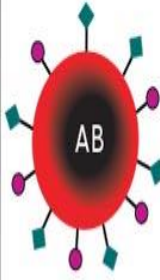
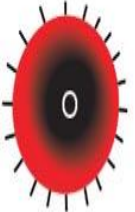


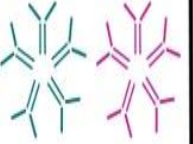



	Group A	Group B	Group AB	Group O
Red blood cell type				
Antibodies present	 Anti-B	 Anti-A	None	 Anti-A and Anti-B
Antigens present	 A antigen	 B antigen	 A and B antigens	None

ABO Blood Type

You make **antibodies** against the **antigens** of other blood types. .

- *Q: Which blood type can accept anyone's blood.*
- *Q: Which blood type is known as the "universal donor. Why?"*

Phenotype	Genotype
Type A	$I^A I^A$ or $I^A i$
Type B	$I^B I^B$ or $I^B i$
Type AB	$I^A I^B$
Type O	ii

	Group A	Group B	Group AB	Group O
Red blood cell type				
Antibodies present	 Anti-B	 Anti-A	None	 Anti-A and Anti-B
Antigens present	 A antigen	 B antigen	 A and B antigens	None

ABO Blood Type

If you are infused with incompatible blood, _____ occurs.

The antigens in your blood bind to the antibodies of the donor blood and cause the blood to clump.

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Anti-A Anti-B Anti-D

Name (Name/ Nom) _____

Geb.Dat. (Date of Birth/ Date de Naissance) _____ Kons.-Nr. (Unit No./ No. Poche) _____

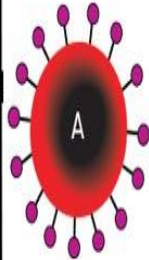
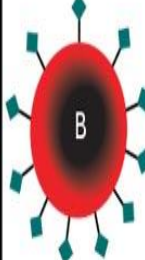
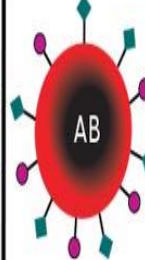
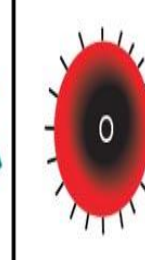


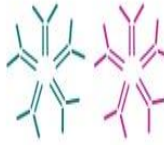
Datum (Date) 1/1 Blutgruppe (Blood Group/ Groupe Sanguin) A POS

Unterschrift (Signature) _____

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Distributed by Biotest AG D-63303 Dreieich

SIFIN **Biotest**

	Group A	Group B	Group AB	Group O
Red blood cell type				
Antibodies present			None	
Antigens present	A antigen	B antigen	A and B antigens	None

Confused?

Here are links to fun resources that further explain genetics & heredity:

Smart Links

- [Genetics & Heredity](#) Main Page on the Virtual Cell Biology Classroom of [Science Prof Online](#).
- ["Pass the Peas"](#) song by James Brown performed by the James Brown Tribute Tour.
- [Independent Assortment](#) animation, step-through and quiz, WHFreeman.
- ["I Think I'm Going Bald"](#) song by Rush.
- [Mendel's Experiments](#) animation, step-through and quiz, Freeman, S, Biological Science, Second Edition, Pearson Prentice Hall, Inc.© 2006 Pearson Prentice Hall, Inc.
- ["Behind Blue Eyes"](#) song by The Who.
- ["She Blinded Me With Science"](#) music video Thomas Dolby.



(You must be in PPT slideshow view to click on links.)

Mendelian Inheritance Activity

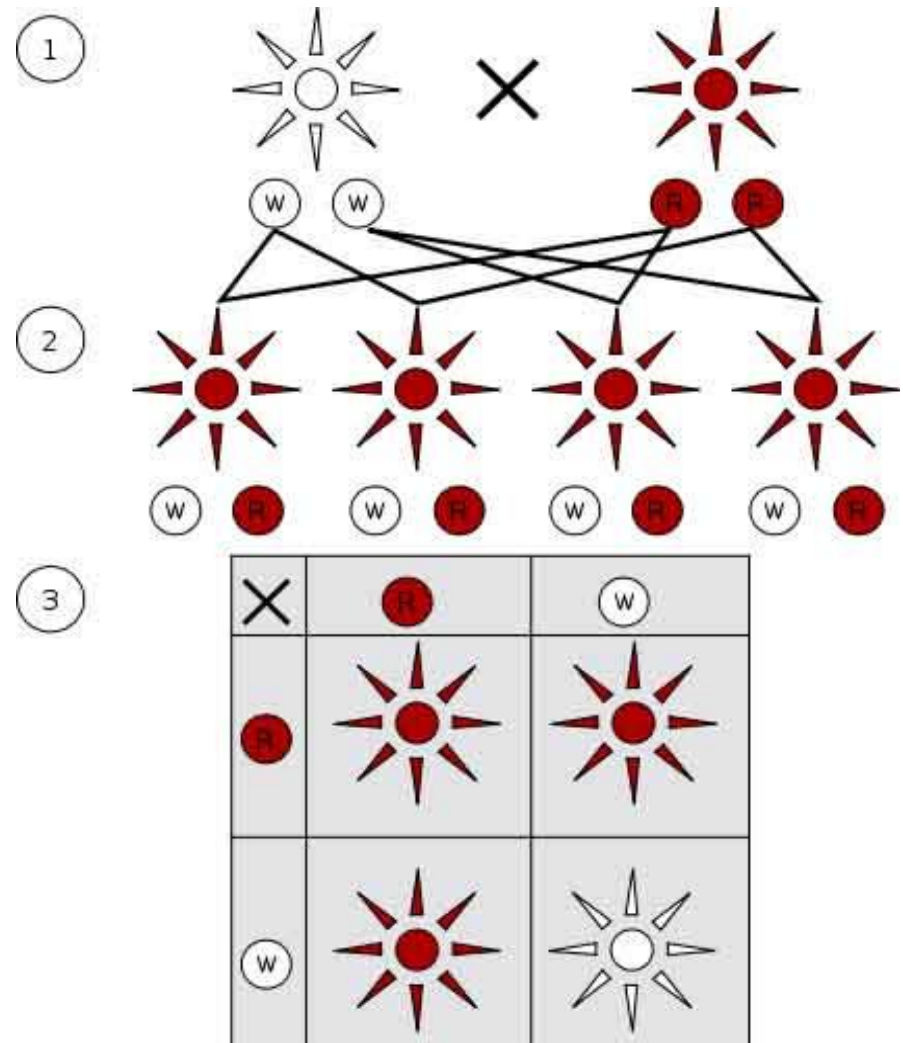
See the [ScienceProfOnline](#) Virtual Cell Biology Classroom **Mendelian Genetics & Heredity** for a printable Word .doc of this assignment.

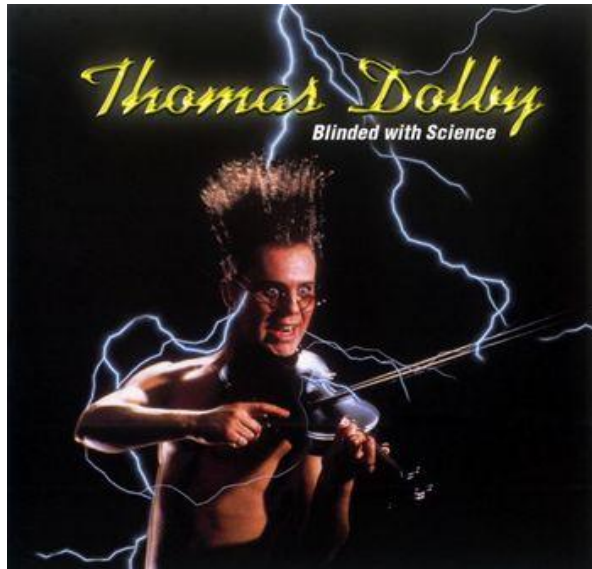
Now it's time to work on the **Mendelian Inheritance** worksheet.

You may work in groups, helping each other interpret traits.

Raise your hand if you would like my help.

Completed worksheet is due before you leave class today.





Are you feeling blinded by science?

Do yourself a favor. Use the...

Virtual Cell Biology Classroom (VCBC)!

The VCBC is full of resources to help you succeed,
including:



- practice test questions
- review questions
- study guides and learning objectives
- PowerPoints on other topics

You can access the VCBC by going to the Science Prof Online website
www.ScienceProfOnline.com